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No. 182

THE HANRIOT-BICHE 110 C1 AIRPLANE (FRENCH)
An All-Metal Low-Wing Pursuit Monoplane

Washington
July 1933

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THE HANRIOT-BICHE 110 C1 AIRPLANE (FRENCH)*

An All-Metal Low-Wing Pursuit Monoplane

By René Rabion

Jean Biche has just produced, at Hanriot's factory, a pursuit airplane of a very particular type which affords a satisfactory solution of the difficult problem of visibility. For this purpose he decided to leave the beaten paths and design an airplane with perfect visibility by placing the pilot in front of the wing and engine (figs. 1 to 4). In reality it is an old idea, the Wright and the Farman airplanes of the war period having had total visibility (fig. 5).

This arrangement was discarded, probably for two reasons, the first one being the seriousness of accidents in the event of capsizing. At that time the structures were weak and, when an airplane turned over, the pilot received the engine on his back after it had burst the fuel tank. The second reason was the success of the frontal engine with tractor propeller which soon came into general use.

Mr. Biche claims that the engine can now be safely put behind the pilot with the following impressive series of advantages:

1. Improvement of the aerodynamic fineness;
2. Reduction in weight with retention of same safety factor;
3. Improvement in the efficiency of the propeller which has a clear field for the slipstream. The efficiency of a pusher propeller remains constant, while that of a tractor propeller is lowered in climbing;

*From Les Ailes, March 30, 1933, p. 3; and L'Aéronautique no. 168, May 1933, pp. 103-108.

4. Reduction of the longitudinal inertia and consequent improvement in the maneuverability, the engine being situated at the center of gravity. Moreover, any type of engine may be used without disturbing the balance;
5. Reduction of fire hazards. If there is a fire on board, the flames are swept back where there are only metal control surfaces;
6. Reduction of the danger of poisoning by the exhaust gases, especially when fuels are rendered antidetonant, as is now common, by tetraethyl lead which is a violent poison;
7. Reduction of the risks of asphyxiation by carbon tetrachloride when used as a fire extinguisher;
8. Ability to use machine guns without synchronization and consequently to increase the rapidity of fire. It is difficult to synchronize fire through three-blade propellers. This advantage is very great for large-caliber automatic guns;
9. Effective protection by the engine against attacks from the rear, which are the most dangerous;
10. Increase in comfort through diminution in the noise of the exhaust. With the engine in front, the sound reaches the pilot at its own speed plus that of the airplane, i.e., $330 + 100 = 430$ m/s (1,411 ft./sec.). With the engine behind, the speed of the airplane is deducted, $330 - 100 = 230$ m/s (755 ft./sec.), a difference of nearly one half.

On the other hand there is one disadvantage, namely, the danger of capsizing. In the H.-B. 110 this danger has been partially obviated by advancing the landing gear so as to throw more weight on the tail skid, which is possible, due to the action of the slipstream on the stabilizer. There is also a very strong girder extending to the front end of the nacelle and forming a sort of anti-capsizing skid. The danger is further reduced by the low landing speed resulting from the large wing area, and by the good visibility for the pilot.

The H.-B. 110 has successfully passed tests at Bourges under the piloting of Marcel Haegelen. No alterations were necessary in the adjustments or areas of the control surfaces. Three days after the first flight, Haegelen was able to turn the airplane over to the pilot Nique, who confirmed the good impression already made.

Its stability is satisfactory, with engine either running or stopped. There might be some fear regarding the behavior of the tail surfaces mounted cantilever fashion on the two tail girders, but Haegelen, having had rear-view mirrors mounted for the first flights, observed no vibration; certainly less, he said, than on ordinary airplanes. The performances are not yet known, excepting that the take-off run was 135 m (443 ft.).

It is constructed entirely of metal: duralumin for the framework, special steel for the fittings, and "Maximum" (French magnesium) for some of the covering plates.

This first specimen of a new type has a structural weight of the order of that of conventional airplanes of the same class. In order to avoid accidents, however, abundant material was used, so that it is possible to reduce the weight of future models.

WING

(Figures 6 to 16)

The H.-B. 110 has a low cantilever monoplane wing consisting of three parts: a central and two lateral parts. Each lateral part is tapered and has a rounded tip. The wing structure consists of two spars, transverse frames, and ribs. Each spar has a plain sheet-metal web stiffened on both sides by U's. The flanges consist of a flat strip and two angle pieces. The transverse frames are of a special design, each consisting of two triangular elements mounted as solids of equal strength on the spar flanges. The apexes of the two triangles are riveted together. The whole forms a very strong triangularly braced assembly, which maintains the parallelism of the spars, renders them interdependent, and increases the torsional strength of the wing. There are two planes of bracing by flat wires at the level of each flange. The turnbuckles for these brace wires are secured to sheet-metal gussets, included in the

transverse frames and riveted to the spar flanges. The ribs are made of round tubes shaped to the wing profile and triangularly braced by round tubes. The ailerons occupy all the straight part of the trailing edge. They are supported by two ball bearings and belong to the Frise type, i.e., they open a slot when deflected. Each lateral wing is joined to the central part by hinges of high-tensile steel. The leading edge is formed of sheet metal.

The central part of the wing supports the tail girders, the engine, the cockpit, and the landing gear. Its chord is less than that of a lateral part at its root, due to the cut-out required for the pusher propeller. Its thickness increases to 0.5 m (19.7 in.) at the plane of symmetry of the airplane. It has two parallel spars, strong transverse frames, and a double system of brace wires. The spars, like those of the lateral parts, have a plain web reinforced by U's. Each flange consists of a wide duralumin plate with two angles and reinforced parts. The transverse frames are sheet-metal partitions. The profile is formed by arches, the outer edges of which join the profile of the lateral wing parts. Longitudinal U strips support the stressed covering. The leading edge consists of semi-arcs joined in pairs and connected by a small spar. The rear edge consists of U's riveted to the profile. The metal covering is riveted to this assembly. This participates in the stresses.

GIRDERS AND TAIL SURFACES

(Figures 17 to 24)

The ordinary fuselage is replaced by two parallel girders about 3.1 m (10.2 ft.) apart. Each of these consists of two shells of sheet duralumin joined in the vertical plane by outside rows of rivets which can be easily set by machine. These shells have flat sides, but are shaped top and bottom with a radius of curvature such that the sheet metal will not fold when the girder is subjected to bending stresses. They are stiffened inside by two longitudinal U's and two vertical, stamped semipartitions.

Each girder is attached by two adjustable ball joints to the corresponding end frame of the central part of the wing and is also attached by an oblique brace wire to the next frame, thus acquiring satisfactory rigidity. In the

region of maximum stress, cylindrical springs are riveted to the assembly lines of the two half-shells. The stabilizer connects the girders by two pairs of ball joints, which also increase their rigidity. The control surfaces are thus supported without appreciable deformation.

The horizontal empennage is rectangular with rounded extremities. The elevator is between the two girders. It is provided with a small Flettner tab. The vertical empennage is located in the plane of symmetry of the airplane at 2.5 m (8.2 ft.) from the propeller. The fin is braced by two pairs of streamline wires. The rudder is not compensated, but is also provided with a small Flettner tab. All the tail surfaces have metal frames and coverings.

PILOT'S COCKPIT

(Figures 25 to 28)

The pilot's seat is over a very strong girder which is suspended from the central part of the wing spars and which forms a spur for protecting the cockpit in case of capsizal. This girder also supports, on the right and on the left, the two machine guns which are placed in the bottom of the cockpit and which fire without synchronization. The seat is adjustable both vertically and longitudinally. It has a system of rubber cords ("sandows") which give it great flexibility.

The control lines, both for the stick and for the rudder bar, consist of rigid tubes which pass through the tail girders. They are guided by a system of ball bearings. The cockpit consists of a series of transverse frames and is flexibly mounted. Access is facilitated by a small door (figs. 29 and 30).

POWER PLANT

(Figures 31 to 40)

The engine is a Hispano-Suiza 12 Xbrs generating 600 hp. at 4,500 m (14,760 ft.), the standard engine for pursuit airplanes of the 1932 program. It is mounted in the

c.g. of the airplane. It rests on a plate connecting the two spars of the central wing section, which have horizontal flanges. The oil radiator is placed under the engine in the center of the airplane. The protected fuel tank is in the bay at the right of the central part.

The water radiator is a very interesting device, considering the difficulty of cooling a high-power supercharged engine. It is an annular flat-tube radiator mounted in the nose of the fuselage like a radial engine. The resemblance is increased by the use of an N.A.C.A. cowl. In the center there is a spherical cap which the pilot can shift horizontally by means of a hand lever actuating a screw. When the cap is pushed forward, the air passage is restricted. The rearmost position yields the maximum air flow. The air, after passing through the radiator, passes out around the nacelle just as in the standard N.A.C.A. cowl. This system has worked well from the first. In addition to the other advantages of this arrangement, both the inlet and outlet water pipes serve to warm the pilot's cockpit. The same purpose is served by a small radiator in the cockpit, the water flow being regulated as a by-pass.

LANDING GEAR

The landing gear proper consists of two faired wheels, each carried at the apex of an inverted trihedral composed of a bent axle, a vertical oleo strut, and a rear bracing strut. This conventional landing gear will ultimately be replaced by a retractable landing gear which will still further increase the fineness of the airplane.

At the rear there is a swiveling tail wheel mounted under the rudder and braced by two pairs of streamline wires attached to the girder tips.

CHARACTERISTICS

| | | |
|--------------------------------------|----------------------|-----------------|
| Span | 13.5 m | 44.29 ft. |
| Length | 8.0 " | 26.25 " |
| Height (without propeller) | 2.7 " | 8.86 " |
| Wing area | 24 m ² | 258.33 sq.ft. |
| Aspect ratio | 7.6 | |
| Gross weight | 1,736 kg | 3,827 lb. |
| Engine power at 4,500 m (14,760 ft.) | 600 hp. | |
| Wing loading | 73 kg | 160.94 lb. |
| Power " | 2.9 kg | 6.39 " |
| Power per unit area | 25 hp/m ² | 2.32 hp./sq.ft. |

PERFORMANCES

Since the H.-B.110 is now being tested, no performance can yet be published. According to the first results, it is thought the performances will be of the order of the other competing pursuit airplanes, i.e., it will attain a speed of 350 to 360 km (217 to 224 miles) per hour at 5,000 m (16,400 ft.).

LEGENDS*

FIGURE 1.-The Hanriot 110 one-place pursuit airplane.

FIGURE 2.-Ditto

FIGURE 3.- "

FIGURE 5.-Visibility on Hanriot 110. These diagrams were obtained by perspective. The left-hand diagram represents the visibility with pilot's head in normal position; the central diagram shows the areas hidden when the pilot's head is 20 cm (about 8 in.) to the right, the diagram for the corresponding left-hand position being symmetrical with this. The right-hand diagram is the result of superposing the diagrams for the three positions. The ratios of the area seen in each of the rectangles a, b, c, d, e, to the maximum visible in this rectangle are: a, 0.87; b, 1; c, 0.61; d, 1; e, 0.54. The coefficient of visibility in taking off and landing (top center) are: a, 0.31; b, 0.96. We cannot give the exact figures for visibility in firing, but they are obviously excellent.

FIGURE 7.-Top of center section showing attachments A, A' on top flange of front spar.

FIGURE 11.-Wing attachments.

FIGURE 12.-Extreme right of center section, to which the lateral wing is attached by four pins.

FIGURE 13.-Assembly of engine bearer, wing, and cockpit. Covering supports are closer near engine to permit walking over them.

FIGURE 17.-Central structure and engine support. L, L', wing spars. E, one of the transverse frames supporting the engine bearer through the ball joints R. A strong girder P, P', which supports the nacelle, is attached to the transverse frames at A, A₁ and A', A'₁. The strong partition between engine and cockpit is not shown.

FIGURE 18.-Nacelle structure, showing girder in front of nacelle, rear partition, and crank for operating radiator cap.

*From L'Aeronautique no. 168, May 1933, pp. 103-108.

FIGURE 20.--Tail girder showing screw attachments for stabilizer.

FIGURE 21.--Attachment of a tail girder to center section by two ball joints.

FIGURE 22.--Water-cooling system. B, drain and filling cock; C, radiator cowl; D, hemispherical radiator cap; M, crank for moving cap to regulate air intake; N, gravity feed tank (forming head rest for pilot); P, pump; p and p', drainage outlets; R_a, air-outlet cock; R_v, drain cock; S, safety valve on plug for filling gravity tank; T, thermometer. Radiator of Monel metal of 0.1 mm (0.004 in.) thickness, welded after stamping; weight 29 kg (64 lb.).

FIGURE 23.--Stabilizer frame.

FIGURE 24.--Assembly of fin, stabilizer, and tail wheel.

FIGURE 29.--Aileron control. The ailerons are controlled directly in torsion. The diagrams at the right show the deflections of the ailerons at different speeds for a throw of 20° of the control stick. M, control stick; A, warping rod; G, elastic post of variable height; B, B', transmission rods; r, r₁, r', r₁', linkages. The aileron control is of variable sensitiveness. The deflection of the ailerons corresponding to a given throw of the control stick varies with the speed of the airplane.

An important article published by Mr. Biche* showed: a) that this system diminishes the stresses on the ailerons by mechanically limiting in some degree the loads imposed on them by sudden maneuvers and b) that, with large ailerons (the use of which is desirable to increase the rolling moment and the protection against autorotation), it enables gentle evolutions at high speed.

*Biche, Jean: Problems Concerning the Stability and Maneuverability of Airplanes. T.M. No. 663, N.A.C.A., 1932.

FIGURE 30.--Rudder and elevator controls. All these controls are rigid. The rudder controls pass through the right-hand girder, and the elevator controls through the left-hand girder. They are guided by the tubes G placed at intervals of about one meter (T, control rod; M, bronze liner serving as ball cage; F, outside sleeve). The Flettner tab on the elevator can be controlled during flight by rotation of the cables on the sector S. The transmission is by Bowden cables traversing the upper part of the left-hand girder, B and B' being junction boxes. The rudder also carries a Flettner tab, but adjustable only on the ground. All the bearings are S.K.F. ball bearings.

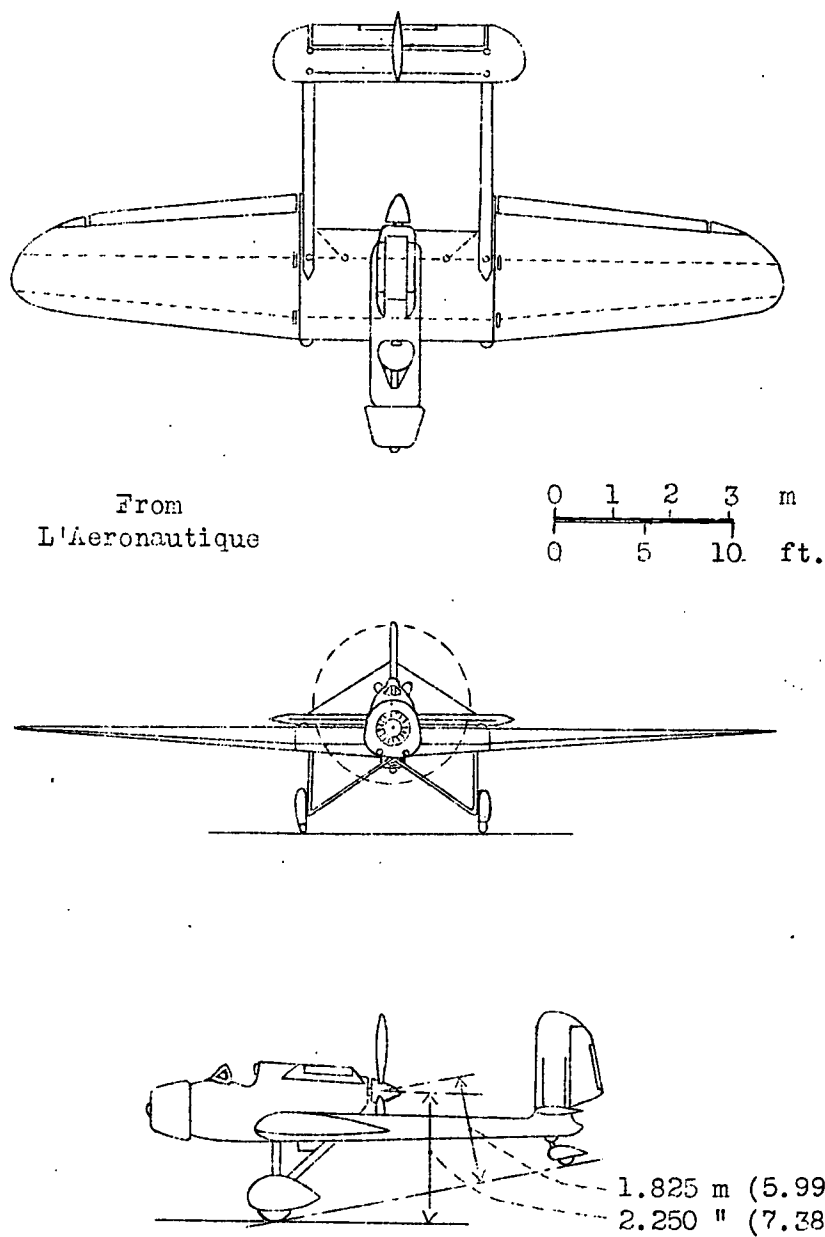
FIGURES 32-34.--Radiator: Figure 32, with cap drawn in; Figure 33, rear view of radiator. It is of the G.L. type with radial blades of conical shape and enclosed in an annular cowl of "maxium" metal 0.8 mm (0.03 in.) thick. The air flow is regulated by a hemispherical cap in the central orifice. The resistance of the radiator is probably thus reduced to a very small value. Figure 34, with cap pushed out.

FIGURE 39.--Fuel system. B, B', filling plugs; C, collector (comprising two connections independently droppable and two cocks r and r' with devices for automatic closing after dropping); F, F', strainers, inspectable without draining, on the intake fuel pipes (see no. 164, p. 12); M_a, Bourdon air manometer communicating with intake p on pipe from compressor; M_e, fuel manometer (equilibrated by air pipe p' symmetrical with p); P, P', rotary pumps; P_j, P_j', intakes for fuel-level indicators; P_R, quarter-turn handle for closing central cock R; P_r, P_r', quarter-turn handles for closing cocks r and r'; R_j', cock of remote fuel-level indicator communicating with P_j' (Badin gage, making it possible to gage both to the right and to the left); V, drain pipe; t, t', tubes for equalizing pressure in pumps. Each tank holds 145 liters (38.3 gal.).

FIGURE 40.--Devices for dumping fuel tanks and automatically closing the stopcocks. Either tank can be dropped separately, the engine then receiving fuel from remaining tank. In the figure, the right-hand tank has been dropped. In order to drop the left-hand tank, unbolt B by pulling on P. The strap S will open and the tank will be thrown out by the rubber cords. In falling, it will actuate a release D, which will first effect the division of the pipe s and then the closing of the corresponding cock on

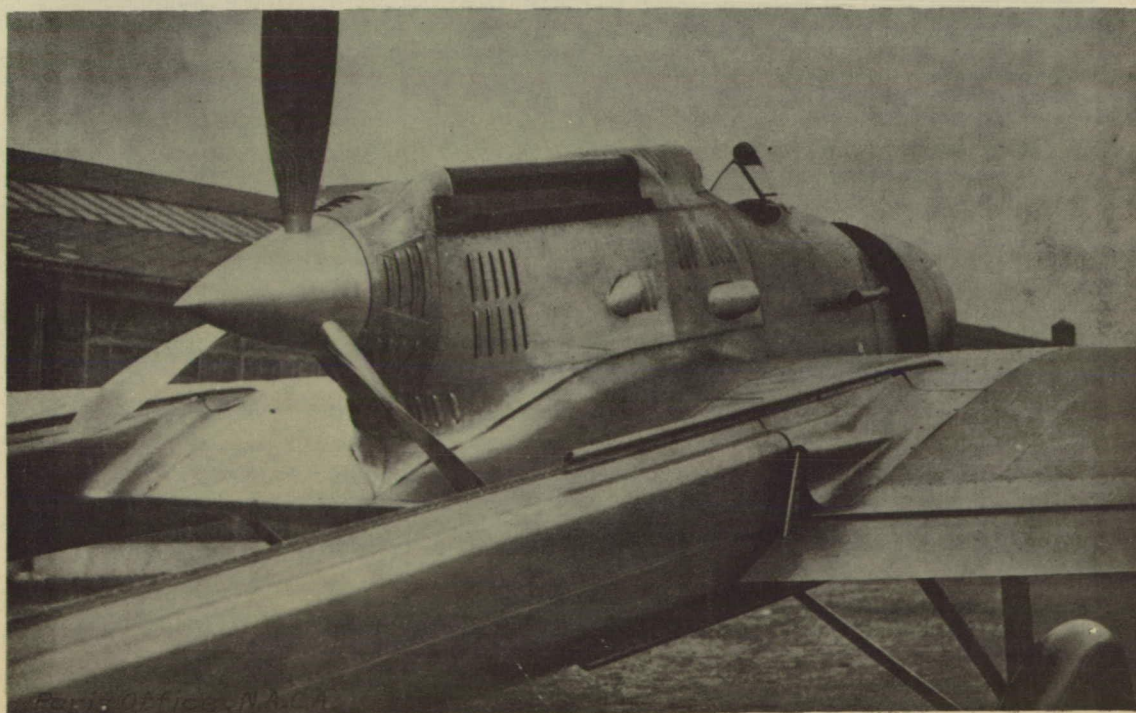
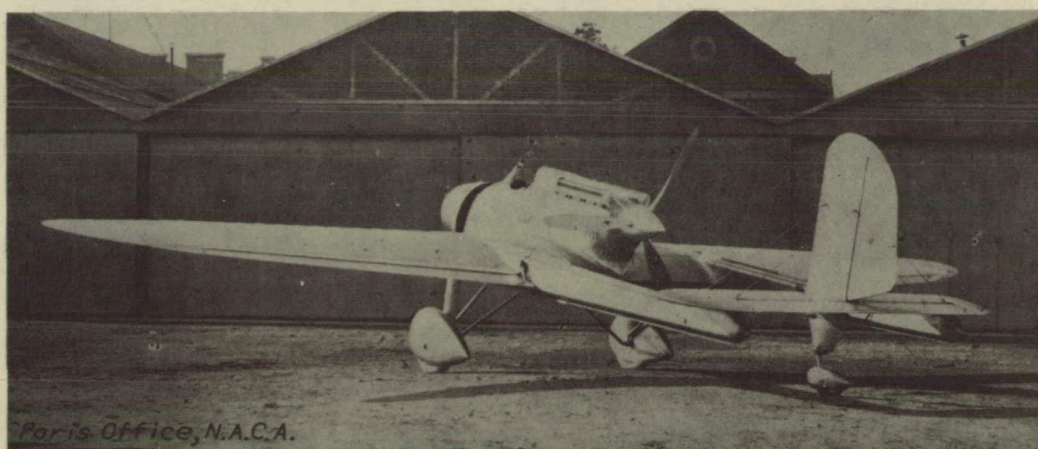
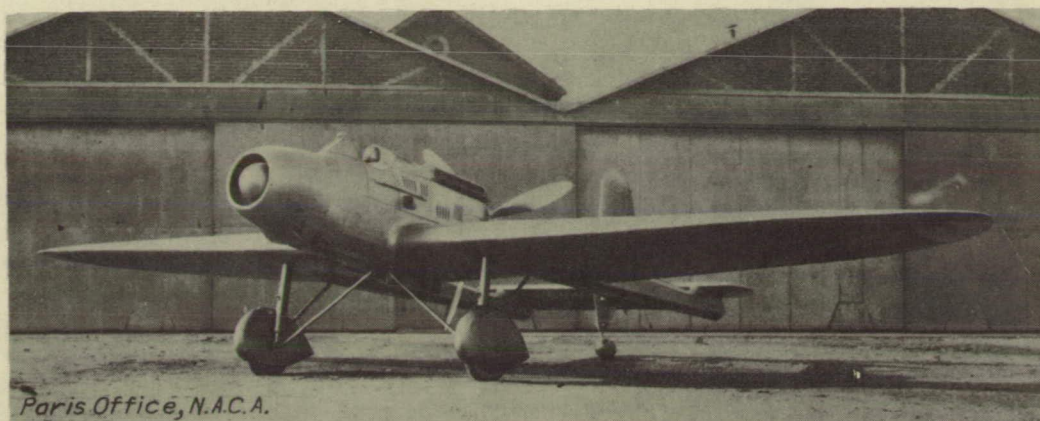
the collecting pipe. The diagrams at the right show this closing device in correspondence with the main figure, i.e., for the right-hand tank. A helical spring R, under tension, is attached to the two drums T and T' of the collecting pipe. If D' divides the brake cord of T', R, supported by the immobile T, causes T' to turn, thus closing the cock.

Translation by Dwight M. Miner,
National Advisory Committee
for Aeronautics.



| | | |
|-----------|---------------------|-----------------|
| Span | 13.5 m | (44.29 ft.) |
| Length | 8.0 " | (26.25 ") |
| Height | 2.7 " | (8.86 ") |
| Wing area | 24.0 m ² | (253.33 sq.ft.) |

Figure 1. - General arrangement drawing of the Hanriot 110 airplane.



Figures 2,3,4.-Views of the Hanriot 110 airplane.

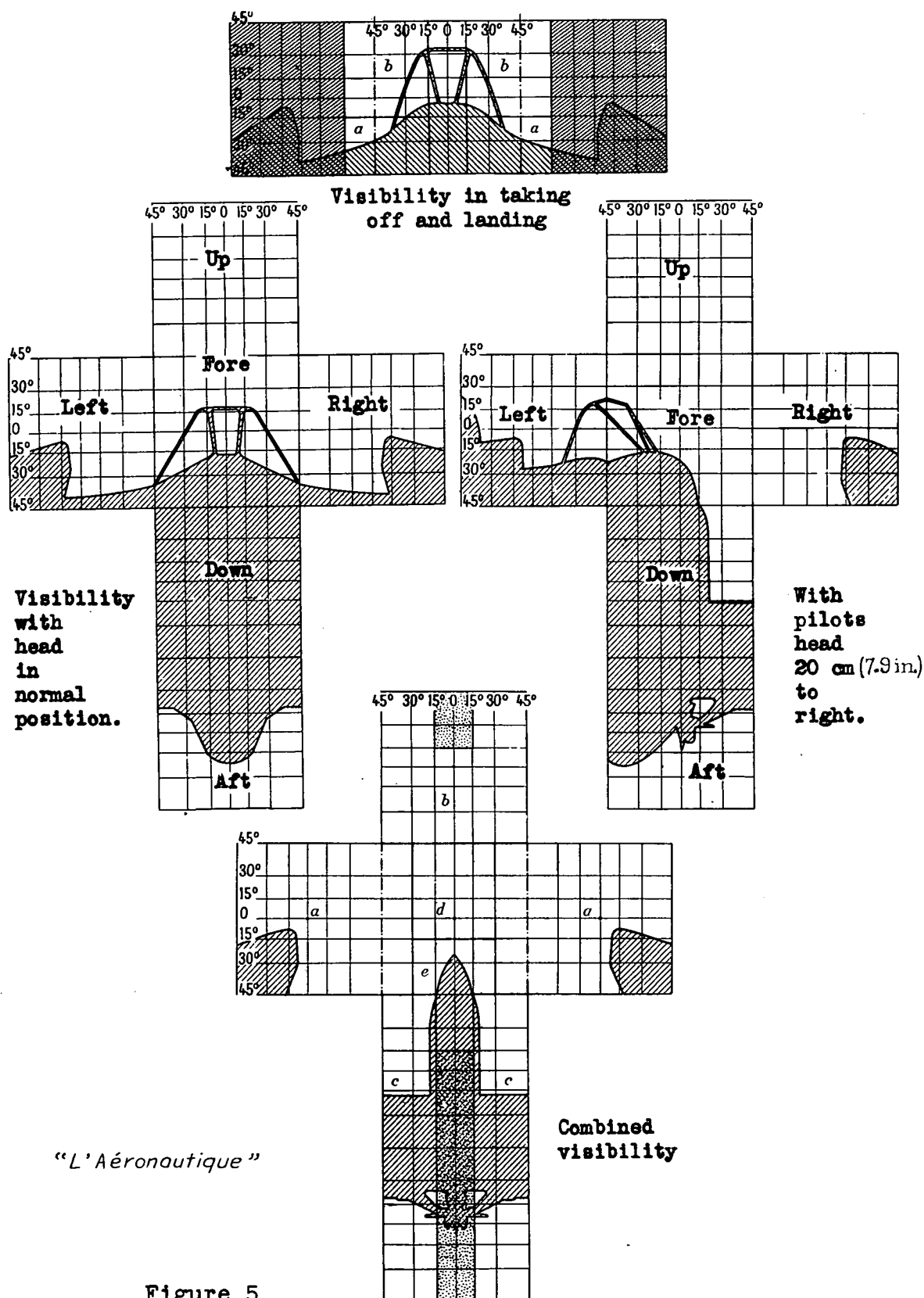




Figure 11

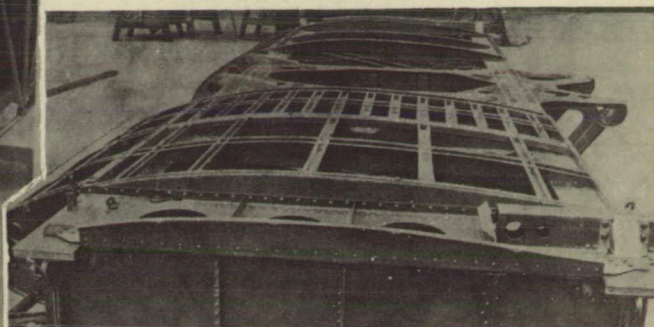


Figure 6

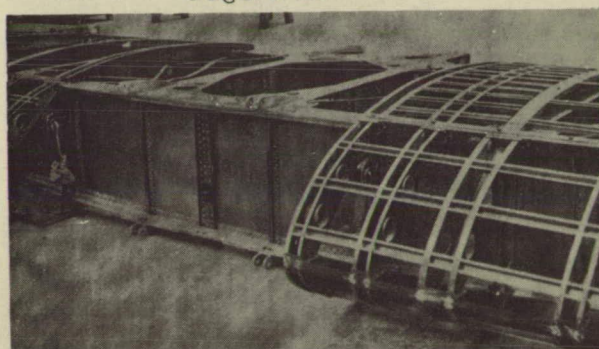


Figure 7

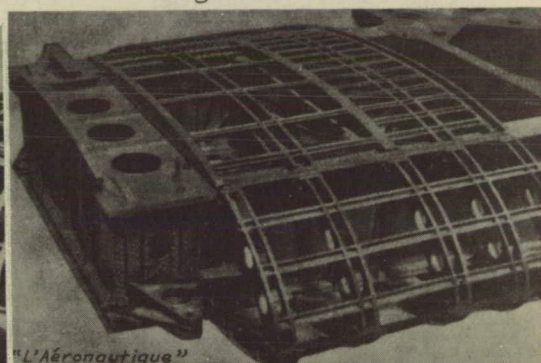


Figure 12

Figs. 6,7,8,9,10,11 Paris Office, N.A.C.A.

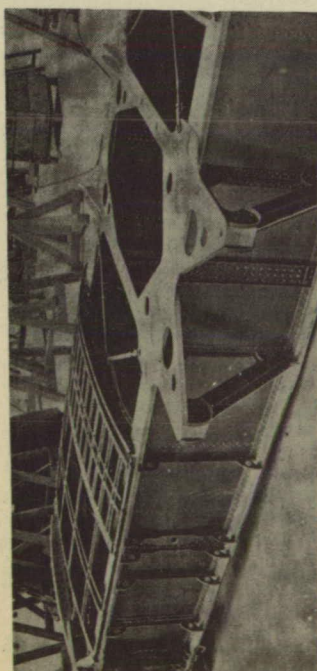


Figure 8

Figure 9

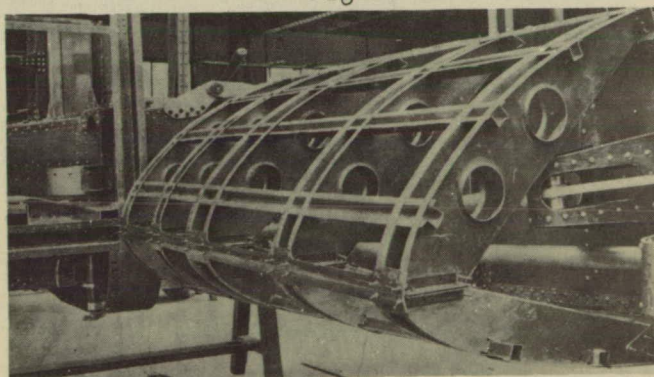


Figure 10



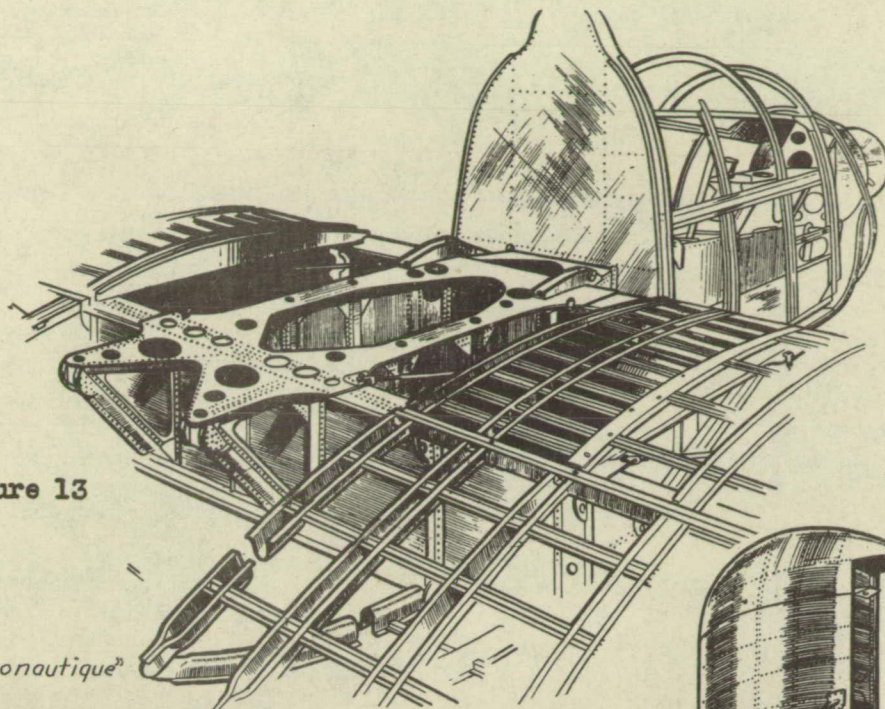


Figure 13

"L'Aéronautique"

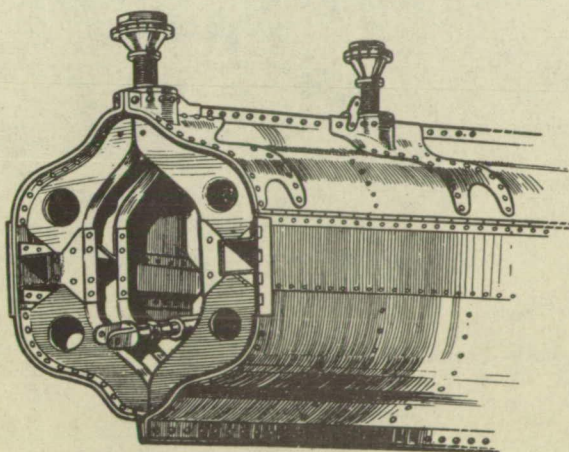


Figure 20

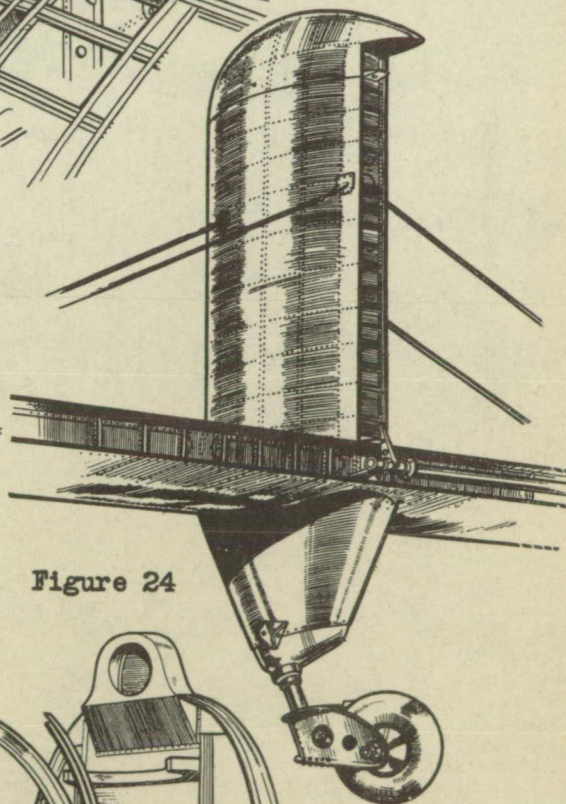


Figure 24

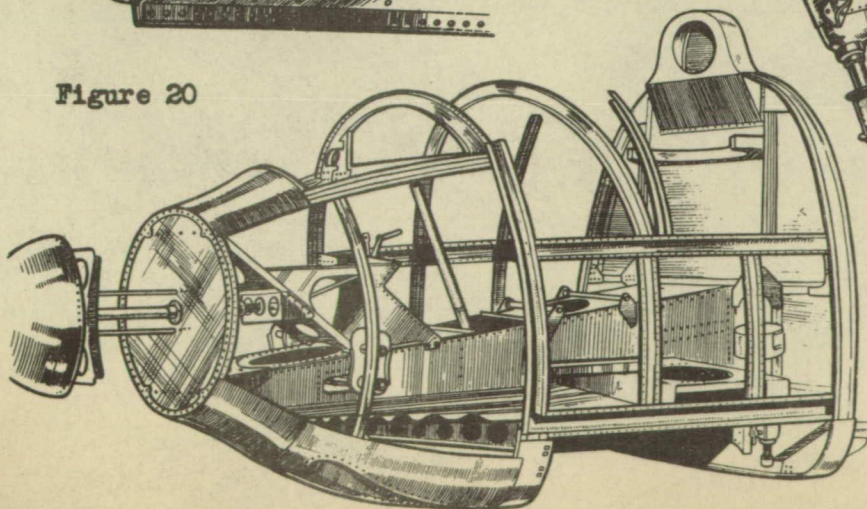


Figure 18

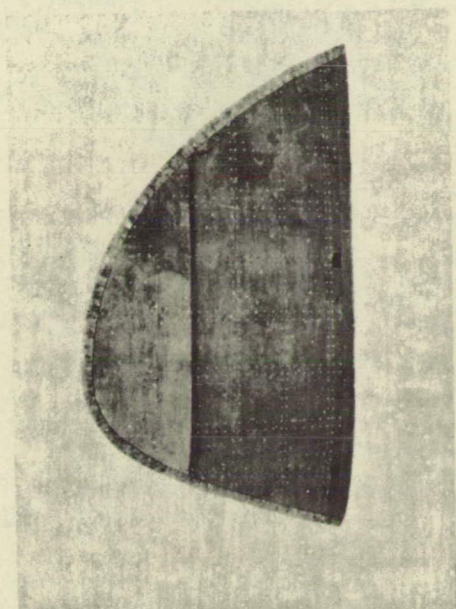


Figure 14

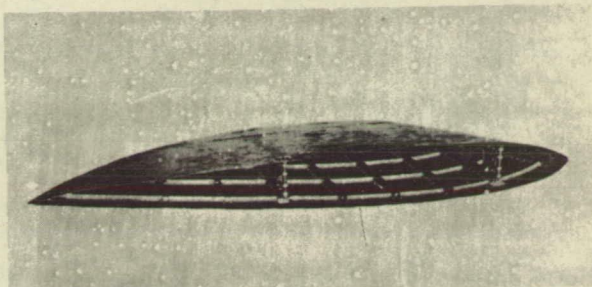


Figure 15

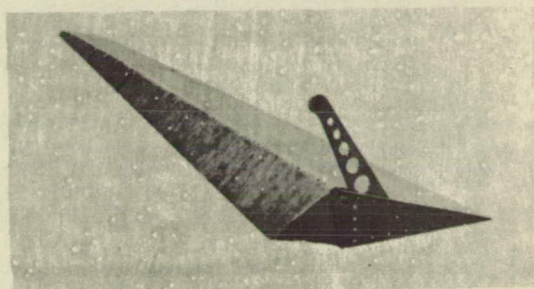


Figure 16

Figs.14,15,16,19,21,22 Paris Office, N.A.C.A.

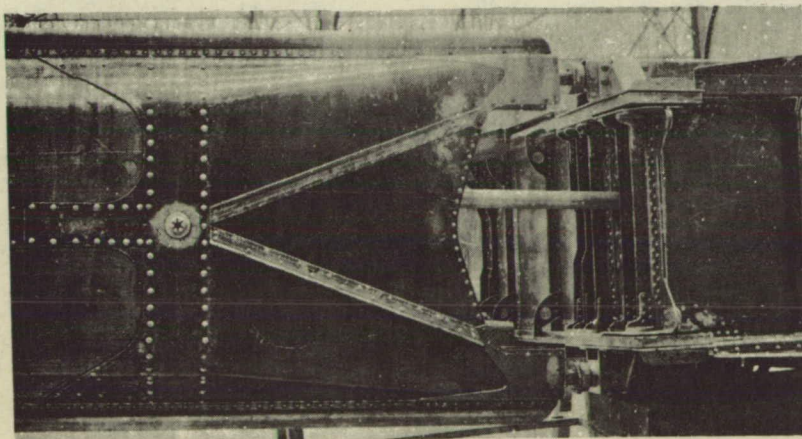


Figure 19

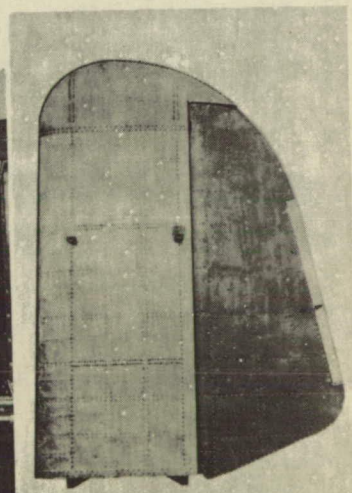


Figure 22

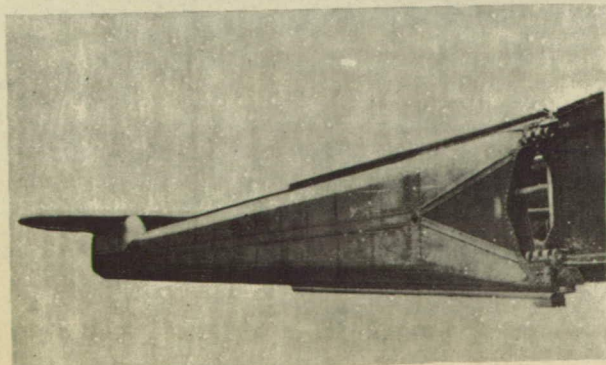
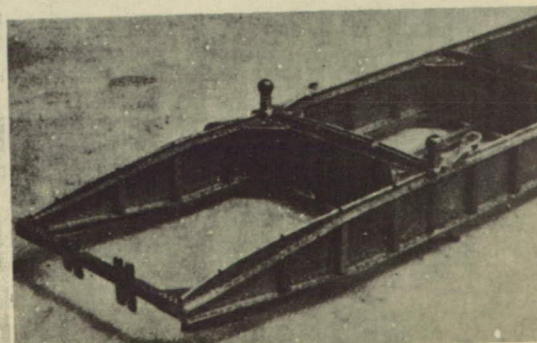
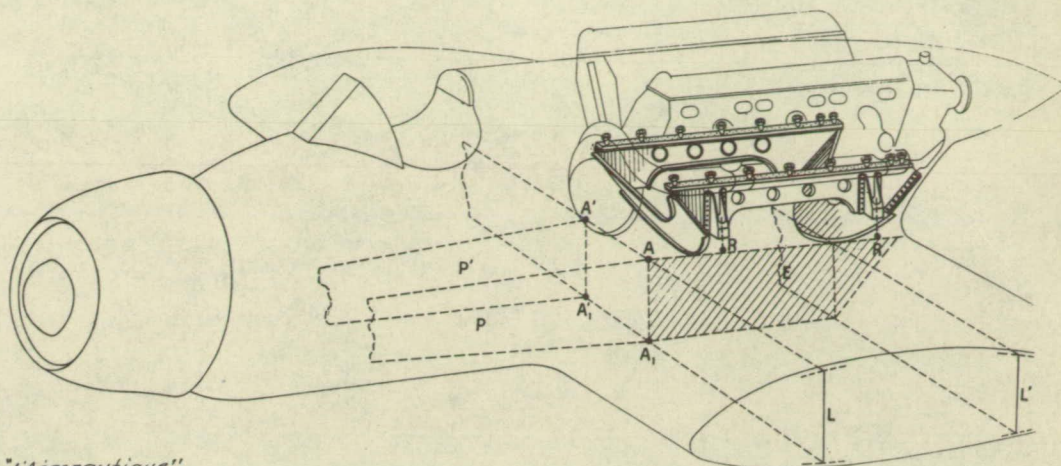


Figure 21

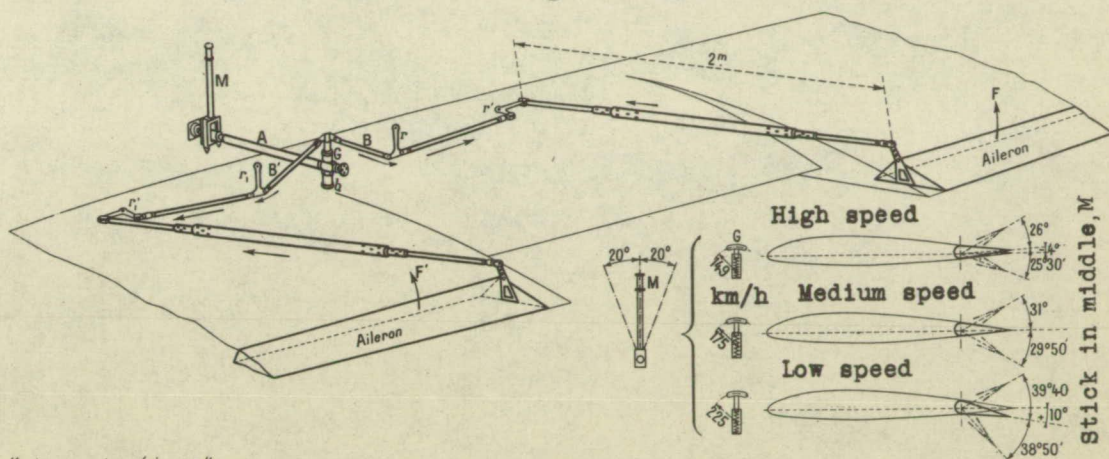


"L'Aéronautique" Figure 23



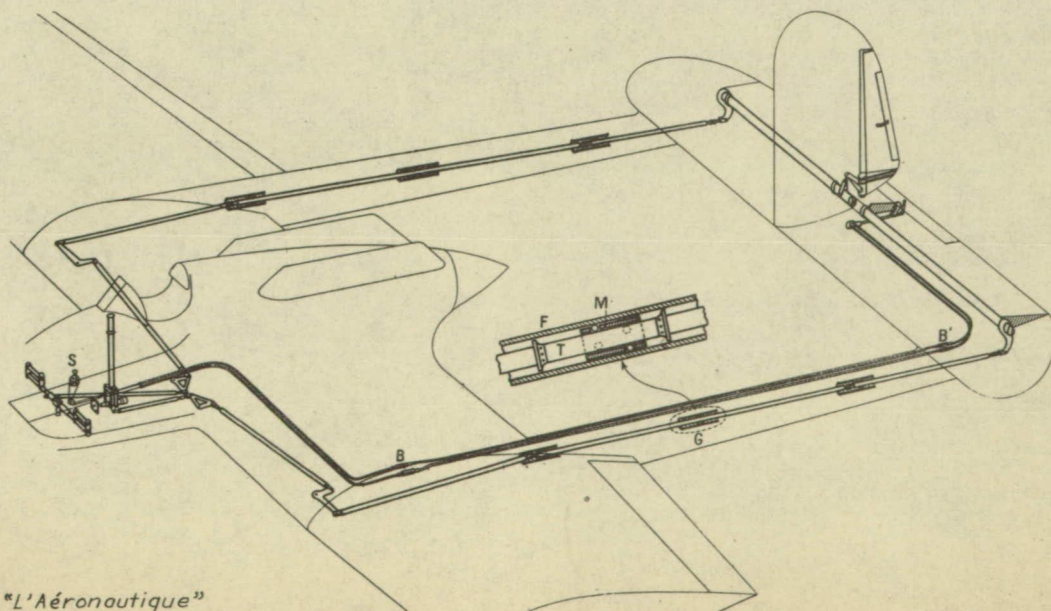
"L'Aéronautique"

Figure 17



"L'Aéronautique"

Figure 29



"L'Aéronautique"

Figure 30

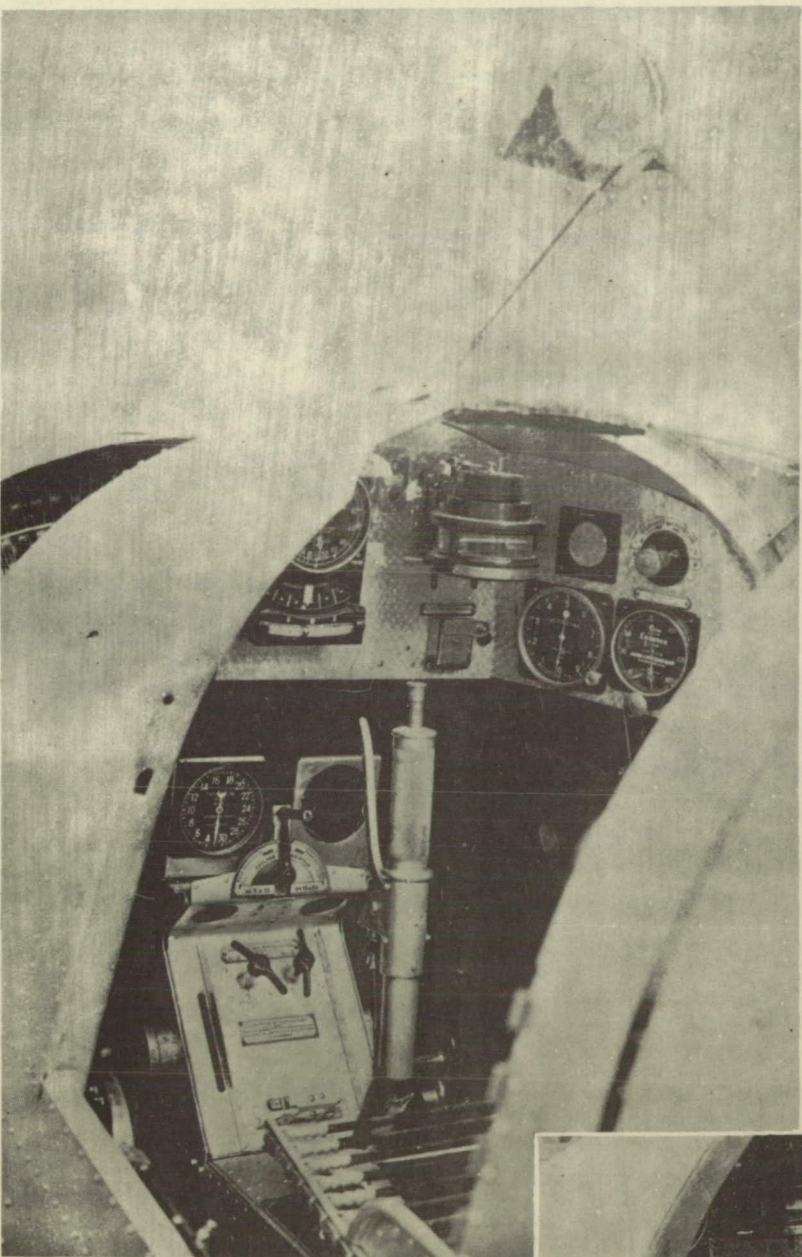
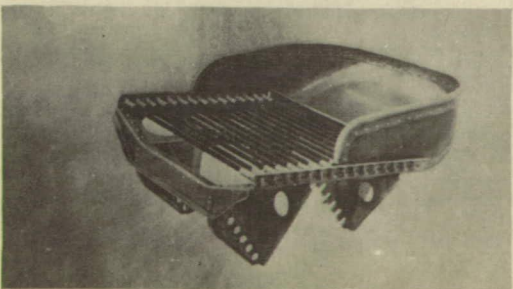


Figure 25



Paris Office,
N.A.C.A. Figure 28

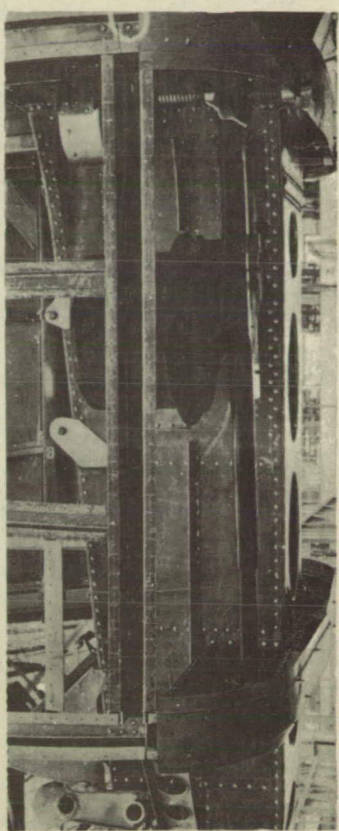


Figure 26

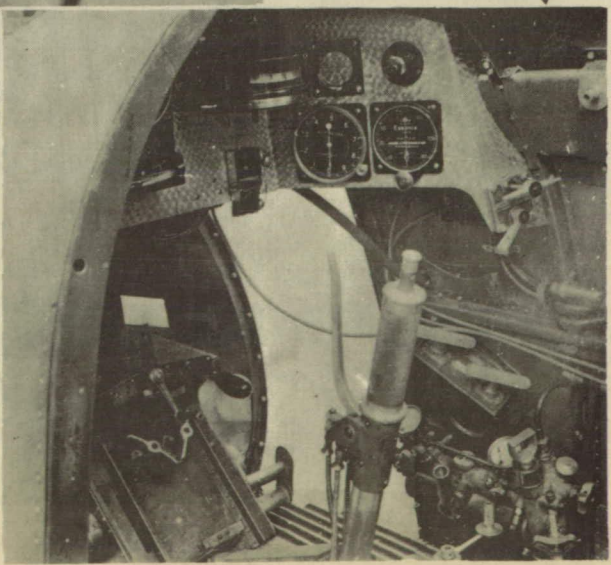


Figure 27

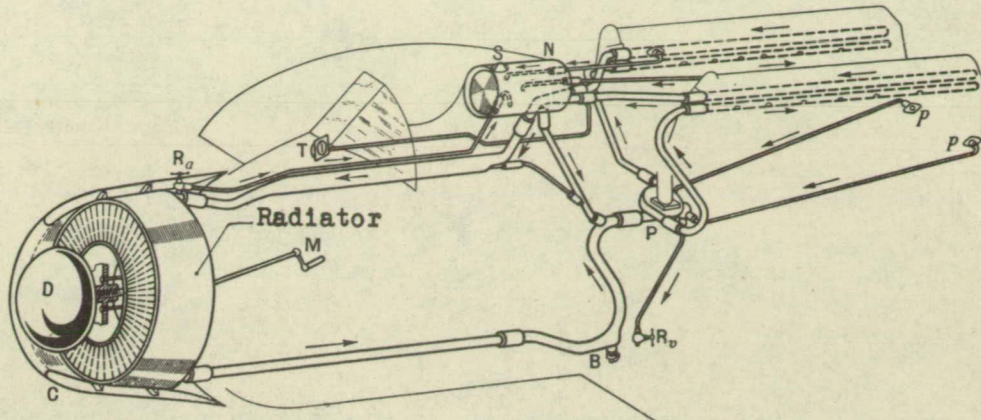


Figure 31

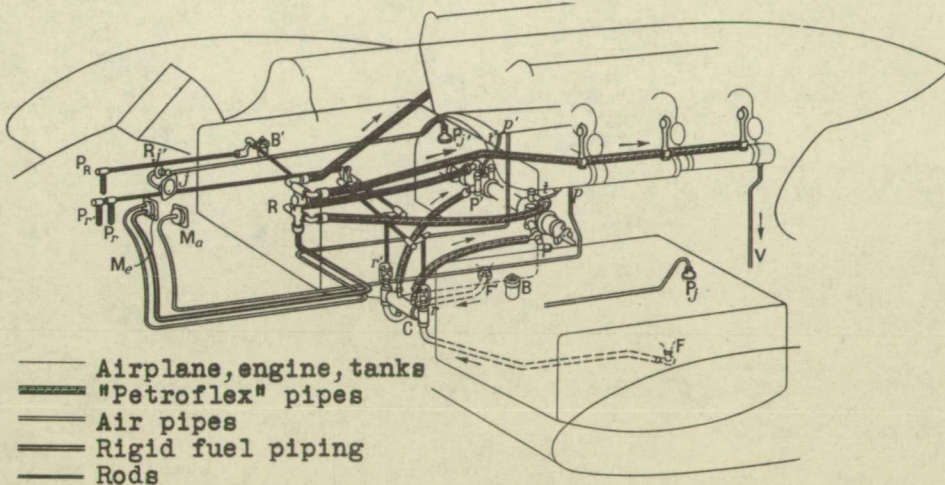


Figure 39

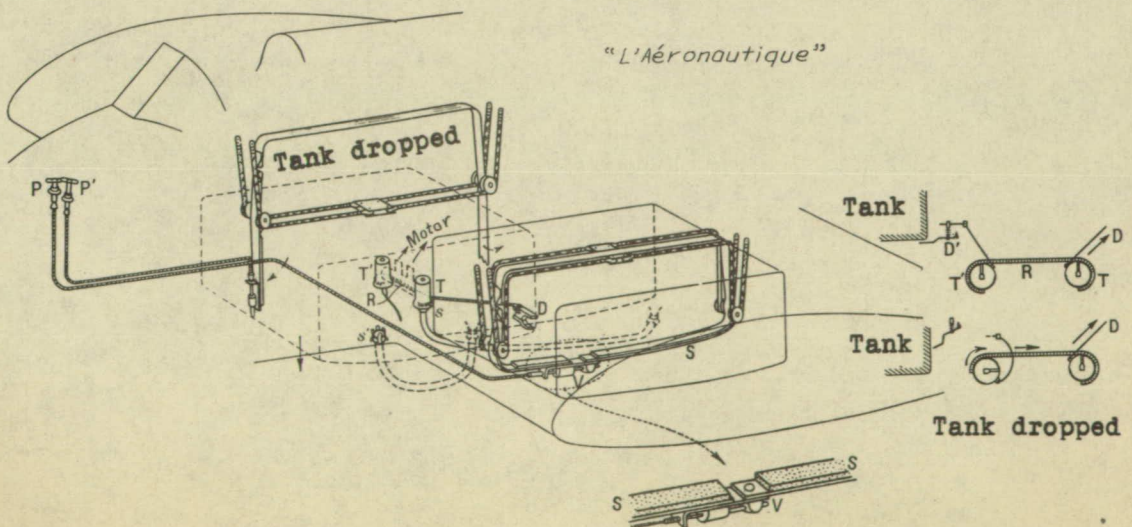


Figure 40

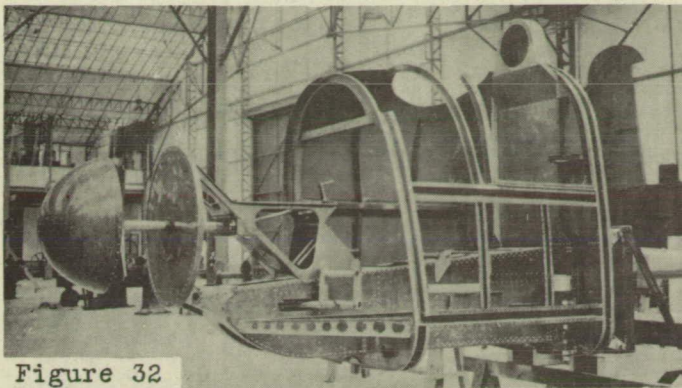


Figure 32

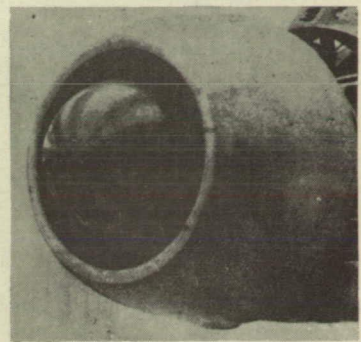


Figure 34

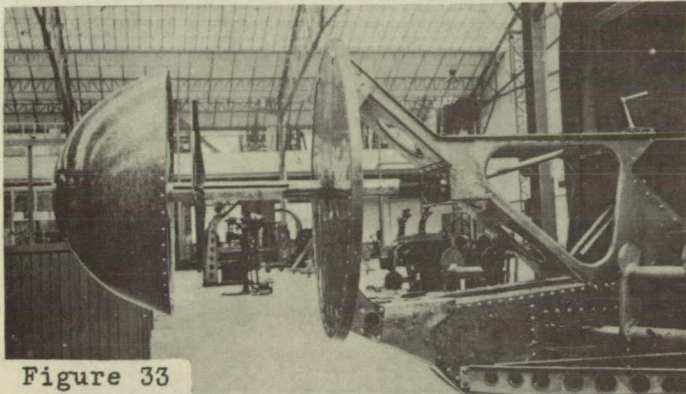


Figure 33

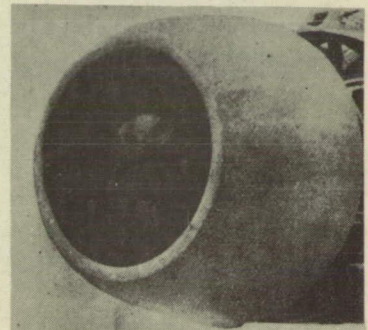


Figure 35

Figs. 34, 35 "L'Aéronautique"

*Figs. 32, 33, 36, 37, 38
Paris Office, N.A.C.A.*

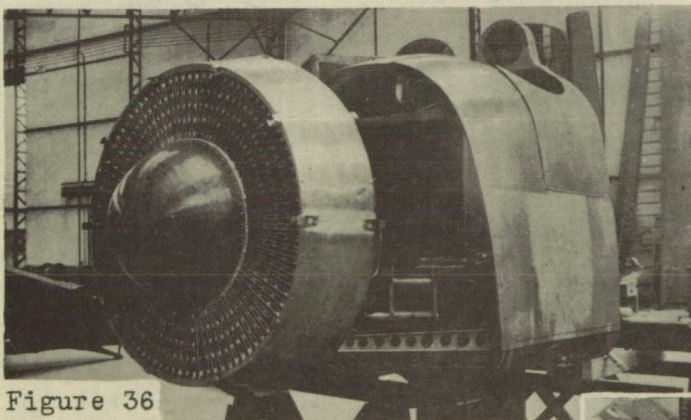


Figure 36

Figure 38

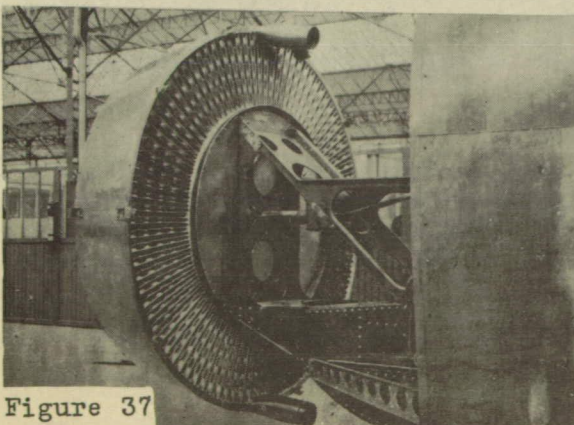


Figure 37

